INTERPRETATION OF PRECAMBRIAN GEOLOGY ALONG THE STRUCTURALLY RESTORED OHIO CONSORTIUM FOR CONTINENTAL REFLECTION PROFILING (COCORP) SEISMIC LINES

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ABSTRACT

A structural restoration of the original 1987 Ohio COCORP seismic lines, reprocessed to 3 seconds two-way time, has clarified the configuration and chronological development of the Fort Wayne rift (an arm of the East Continent Rift Basin) and a series of sediment-filled Precambrian foreland basins east of the previously accepted Grenville Front. Grenville deformation post-dated development of the East Continent Rift Basin and associated Precambrian Middle Run Formation sedimentation. Grenville foreland basins developed in an east-to-west sequence during progressive westward thrusting. The foreland basins were filled with sediment derived from the Grenville-age mountains to the east. Early-formed Grenville basins were then partitioned and partially overthrusted by advancing Grenville thrust sheets. East Continent Rift Basin rift assemblages were also folded and transported westward. Grenville foreland basins are defined by (1) marked impedance contrasts of seismic reflectors between essentially horizontal basin fill and underlying Grenville metamorphic rocks, and (2) abnormally low interval velocities in basin strata. Structural restoration of fault displacements at the basin-fill/Grenville metamorphic rock unconformity reveals a geometry that supports an interpretation of three large foreland basins that were later progressively partitioned as Grenville thrusting advanced from east to west. Total shortening at the top of the Grenville sequence is about 13 percent across Ohio from the West Virginia border to the western boundary of the Grenville tectonic zone in west-central Ohio. Horizontal shortening appears to culminate within the tectonic zone at about 16.5 percent.

This new interpretation presents the possibility of a previously unknown regional exploration play in low-velocity foreland- basin-fill sediments and reaffirms the effects that Precambrian structures have had on Paleozoic geology. The fundamental architecture and extent of the Central Ohio Platform and the Appalachian Basin date from the time of East Continent Rift Basin development through Grenville deformation, although shallow well control in Ohio defines the Appalachian Basin only to late Ordovician time. Well control confirms (1) the absence of the Mount Simon Sandstone on basement horst blocks, and (2) presence of anomalously thick Mount Simon and older sediments in grabens, which appear to be related to Precambrian structures. Younger structures and faults of Late Ordovician to Mississippian age, are also related to reactivated Precambrian structures, and define a series of terraces, bounded by monoclines, which step eastward down into the early Appalachian Basin. These faults and structures, and, in part, controlled facies distribution and subsequent hydrocarbon accumulation during the Paleozoic. Drilling has yet to confirm or refute the presence of the Grenville foreland basins.

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